09-08-00 A

JC916 U.S. PTO 09/07/00

Please type a plus sign (+) inside this box → +

PTO/SB/05 (2/98)
Approved for use through 09/30/2000. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR § 1.53(b))

Attorney Docket No.	4015-677
First Inventor or Application Identifier	Alex Krister Raith
Title	METHOD TO CONTROL THE OPDATE FREQUENCY OF A POSITIONING DEVICE BY A MOBILE TERMINAL
Express Mail Label No.	EL634166306US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

JC675 U.S. PTO 09/656894 09/07/00

1. ☒ *Fee Transmittal Form *(e.g., PTO/SB/17)*
   (Submit an original and a duplicate for fee processing)
2. ☒ Specification [Total Pages 29]
   (preferred arrangement set forth below)
   - — Descriptive title to the Invention
   - — Cross References to Related Applications
   - — Statement Regarding Fed sponsored R & D
   - — Reference to Microfiche Appendix
   - — Background of the Invention
   - — Brief Summary of the Invention
   - — Brief Description of the Drawings *(if filed)*
   - — Detailed Description
   - — Claim(s)
   - — Abstract of the Disclosure
3. ☒ Drawing(s) *(35 U.S.C. 113)* [Total Sheets 4]
4. ☒ Oath or Declaration [Total Pages 3]
   a. ☒ Newly executed (original or copy)
   b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))
   (for continuation/divisional with Box 17 completed)
   [Note Box 5 below]
   i. ☐ DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).
5. ☐ Incorporation By Reference *(useable if Box 4b is checked)*
   The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. ☐ Computer Readable Copy
   b. ☐ Paper Copy (identical to computer copy)
   c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))
9. ☐ 37 C.F.R. § 3.73(b) Statement ☒ Power of Attorney
   (when there is an assignee)
10. ☐ English Translation Document *(if applicable)*
11. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☒ Copies of IDS Citations
12. ☐ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503)
    (Should be specifically itemized)
14. ☐ *Small Entity Statement(s) ☐ Statement filed in prior application, Status still proper and desired
15. ☐ Certified Copy of Priority Document(s)
    (if foreign priority is claimed)
16. ☒ Other: Express Mail Certification

NOTE FOR ITEMS 1 & 14: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

17. If a CONTINUING APPLICATION, *check appropriate box and supply the requisite information below and in a preliminary statement:*
    ☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: _____/_____
    Prior application information: *Examiner:* *Group/Art Unit:*

18. CORRESPONDENCE ADDRESS

☒ *Customer Number or Bar Code Label* *(Insert Customer No. or Attach bar code label here)* 24112 or ☐ *Correspondence address below*

NAME	PATENT TRADEMARK OFFICE				
ADDRESS					
CITY		STATE		ZIP CODE	
COUNTRY		TELEPHONE		FAX	

Name (Print/Type)	David E. Bennett	Registration No. (Attorney/Agent)	32,194
Signature	David E. Bennett	Date	September 7, 2000

PTO/SB/17 (2/98)
Approved for use through 9/30/2000. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

FEE TRANSMITTAL

Patent fees are subject to annual revision on October 1
These are the fees effective December 29, 1999.
Small Entity payments must be supported by a small entity statement.
otherwise large entity fees must be paid. See Forms PTO/SB/09-12.
See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT | **($) 1,194.00**

Complete if Known

Application Number	TBA
Filing Date	TBA
First Named Inventor	Alex Krister Raith
Examiner Name	TBA
Group Art Unit	TBA
Attorney Docket No.	4015-677

METHOD OF PAYMENT (check one)

1. ☒ The Commission is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 18-1167

Deposit Account Name: Coats & Bennett, P.L.L.C.

☒ Charge Any Additional Fee Required Under 37 CFR §§1.16 and 1.17

☐ Charge the Issue Fee Set in 37 CFR §1.18 at the Mailing of the Notice of Allowance

2. ☒ Payment Enclosed:
☒ Check ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Fee Code	Large Fee ($)	Small Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	690	201	345	Utility filing fee	690.00
106	310	206	155	Design filing fee	
107	480	207	240	Plant filing fee	
108	760	208	380	Reissue filing fee	
114	150	214	75	Provisional filing fee	
				SUBTOTAL (1)	($)690.00

2. EXTRA CLAIM FEES

	Extra Claims		Fee from below		Fee Paid
Total Claims	35	-20** =	15	X 18 =	270
Independent Claims	6	-3** =	3	X 78 =	234
Multiple Dependent Claims				X =	

** or number previously paid, if greater; For Reissues, see below

Large Fee Code	Large Fee ($)	Small Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim
109	78	209	39	**Reissue independent claims over original patent
110	18	210	9	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 504

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Fee Code	Large Fee ($)	Small Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examination action	
115	110	215	55	Extension for reply within first month	
116	380	216	190	Extension for reply within second month	
117	870	217	435	Extension for reply within third month	
118	1,360	218	680	Extension for reply within fourth month	
128	1,850	228	925	Extension for reply within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,210	241	605	Petition to revive - unintentional	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt.	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	760	246	380	Filing a submission after final rejection (37 CFR 1.129(a))	
149	760	249	380	For each additional invention to be examined (37 CFR 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 0

SUBMITTED BY				Complete (if applicable)	
Typed or Printed Name	David E. Bennett			Reg. Number	32,194
Signature	David E. Bennett	Date	September 7, 2000	Deposit Account User ID	18-1167

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Alex Krister Raith

Serial No._____

Filed:_____

For: **METHOD TO CONTROL THE UPDATE FREQUENCY OF A POSITIONING DEVICE BY A MOBILE TERMINAL**

Attorney's Docket No. P-4015.677

Express Mail Certification
Label No.EL634166306US

Raleigh, North Carolina

September 7, 2000

Commissioner for Patents
BOX PATENT APPLICATION
Washington, D.C. 20231

Sir:

EXPRESS MAIL CERTIFICATE LABEL NO. EL634166306US

DATE MAILED: September 7, 2000

I hereby certify that the enclosed Utility Patent Application Transmittal, Fee Transmittal Form (2 copies), specification and claims, drawings (1 set of 4 sheets), Declaration and Power Of Attorney, Information Disclosure Form (PTO-1449) and copies of cited patents, and our Check # 2501 in the amount of $1,194.00 are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. §1.10 on the date indicated above and is addressed to Commissioner for Patents, BOX PATENT APPLICATION, Washington, D.C. 20231.

Respectfully submitted,

COATS & BENNETT, P.L.L.C.

By: David E. Bennett

David E. Bennett
Registration No. 32,194

Telephone: (919) 854-1844

Express Mail Label No.: EL[illegible]66306US
Date Mailed: September 7, 2000

UNITED STATES PATENT APPLICATION FOR GRANT OF LETTERS PATENT

Alex Krister Raith
INVENTOR

METHOD TO CONTROL THE UPDATE FREQUENCY OF A POSITIONING DEVICE BY A MOBILE TERMINAL

COATS & BENNETT, P.L.L.C.
P.O. Box 5
Raleigh, NC 27602
(919) 854-1844

METHOD TO CONTROL THE UPDATE FREQUENCY OF A POSITIONING DEVICE BY A MOBILE TERMINAL

BACKGROUND OF THE INVENTION

The present invention generally relates to position estimating devices and, more particularly, to a method of controlling the update frequency of a position estimating device in a mobile terminal.

The wireless communication industry has made phenomenal strides in commercial operations in the United States and the rest of the world. Growth in major metropolitan areas has far exceeded expectations. If this trend continues, it is possible that wireless communications will provide the bulk of telecommunication services in some areas. As a result of this growth, wireless communication services have become more affordable. In light of the recent trend of competitive air-time rates, customers may choose to make wireless communication devices their primary means of personal communication. The popularity of wireless communication devices is further enhanced by their ability to be used for non-voice communication, such as facsimile and data transmission.

In the near future, wireless communication devices will incorporate position estimating devices to enhance the function and utility of the wireless communication device. Perhaps the best known use of position estimating technology is for navigation. Another common use for position estimating devices is to identify facilities, such as hotels or restaurants, that are nearby the current position of the wireless communication device. Position information can also be used to enhance intrinsic functions of wireless

communication devices. For example, position information can be used to improve cell reselection or hand-off decisions in mobile terminals. Examples of how position information may be used to enhance intrinsic functions of the mobile terminal are illustrated in the following U.S. patent applications: Serial No. 09/498,785 entitled "Position Assisted Handoff in a Wireless Communication Network"; Serial No. 09/505,431 entitled "Position Assisted Service Selection"; and Serial No. 09/498,772 entitled "System and Method For Improving Channel Monitoring In a Cellular System."

Position estimating devices have a broad variety of uses and can significantly enhance the utility and, therefore, the desirability of wireless communication devices

BRIEF SUMMARY OF THE INVENTION

The present invention is a mobile terminal having a GPS receiver or other position estimating device and control logic. The control logic periodically executes a routine to update the current location of the mobile terminal. The position update frequency, i.e., the frequency at which position updates are performed, is varied depending upon the distance between the mobile terminal and a point of interest to reduce the power consumed by the position estimating device. A reference position for the point of interest is stored in the mobile terminal for comparison with the current position of the mobile terminal. In one embodiment, the position update frequency is adjusted so that position updates are less frequent when the mobile terminal is far away from the point of interest and more frequent when the mobile terminal is close to the point of interest. The frequency of position updates may also be dependent on the velocity of the mobile terminal. That is,

the update frequency is made less frequent when the mobile terminal is stationary or moving slowly.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram illustrating the functional elements of an exemplary mobile terminal;

Figure 2 is a flow chart illustrating an exemplary position update procedure according to the present invention;

Figure 3 is a schematic representation of a public and private radiocommunication system;

Figure 4 is an exemplary graph illustrating the relationship between the position update frequency and channel search frequency of the mobile terminal, and the distance between the mobile terminal and a private radiocommunication system.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, Figure 1 is a block diagram of a mobile terminal indicated generally by the numeral 20. The term "mobile terminal" as used herein may comprise a cellular radiotelephone; a Personal Communications Service (PCS) terminal that may combine a cellular radiotelephone with data processing, facsimile and data communications capabilities; a Personal Digital Assistant (PDA) that may include a radiotelephone, pager, Internet/intranet access, Web browser, organizer, and/or calendar; a conventional laptop computer, a palmtop computer, or other appliance that includes a radiotelephone transceiver. Mobile terminals may also be referred to as "pervasive computing" devices.

Mobile terminal 20 may employ a wide variety of communication standards and protocols, which are published by organizations such as the Telecommunications Industry Association/Electronics Industry Association (TIA/EIA) and the European Telecommunication Standards Institute (ETSI), including without limitation Time Division Multiple Access (TDMA) standards such as TIA/EIA-136 and the Global System for Mobile Communications (GSM), Code Division Multiple Access (CDMA) standards such as TIA/EIA-95, Wideband Code Division Multiple Access (WCDMA) standards such as cdma2000, Universal Wireless Communications (UWC) 136, and satellite communication standards such as Globestar. The details of the communication protocols used by the mobile terminal 20 are not material to the invention.

Mobile terminal 20 comprises a main control unit 22 for controlling the operation of the mobile terminal 20 and memory 24 for storing control programs and data used by the mobile terminal 20 during operation. Input/output circuits 26 interface the control unit 22 with a keypad 28, display 30, audio processing circuits 32, receiver 38, transmitter 40, and positioning receiver 50. The keypad 28 allows the operator to dial numbers, enter commands, and select options. The display 30 allows the operator to see dialed digits, stored information, and call status information. The audio processing circuits 32 provide basic analog audio outputs to a speaker 34 and accept analog audio inputs from a microphone 36. The receiver 38 and transmitter 40 receive and transmit signals using shared antenna 44.

Local terminal 20 may also include an alternative interface 56, such as a "Bluetooth" air interface, which may use a separate antenna 58. Bluetooth is a universal radio interface in the 2.45 GHz frequency band that enables portable electronic devices to connect and communicate wirelessly via shortrange, adhoc networks. Persons interested in various details regarding the Bluetooth technology are referred to the article entitled "Bluetooth-the universal radio interface for ad hoc, wireless connectivity" authored by Jaap Haartsen, which can be found in the Ericsson review, Telecommunications Technology Journal, No. 3, 1998, the disclosure of which is incorporated herein by reference. For the purposes of the present invention, only Bluetooth features of immediate interest are described herein.

In Bluetooth systems, a fixed station may act as a master device and continuously transmit INQUIRE messages for receipt by any mobile terminals 20 that

may be in the vicinity of the fixed station. A mobile terminal 20 in the vicinity of the fixed station would recognize the presence of the fixed station. The mobile terminal 20 could then initiate communications with the fixed station over the Bluetooth interface. The fixed station may be part of an alternate communication network as will be hereinafter described in greater detail. Additionally, the mobile terminal 20 includes a position estimator 50 electrically and operatively coupled to a navigation signal antenna 52. Position estimator 50 functions to determine the geographical position or location of the mobile terminal 20 at selected times. Position estimator 50 generates geographic position estimates under the control of the control unit 22 using navigation signals received through navigation signal antenna 52. These navigation signals may be broadcast by navigation satellites, e.g. those of the Global Positioning System (GPS). GPS signal reception and position determination therefrom are well known in the art. Such position determination is disclosed in U.S. Patent 4,968,981 to Sekine, et al., entitled "GPS Receiver Apparatus," the disclosure of which is incorporated herein in its entirety. Other position determining technologies are also available, for example the Russian equivalent to the US operated GPS system. There are also terrestrial based position and navigation systems (e.g. LORAN), which could be used in the practice of the present invention.

Navigation signal antenna 52 receives navigation signals, e.g., from navigation satellites, for the calculation of position estimates. The size and location of navigation signal antenna 52 is illustrative only, and may in practice be pivotably or retractably mounted, may be detachable, or may be designed into the housing of mobile terminal 20.

With a position estimator 50, mobile terminal 20 gains expanded functionality and flexibility in its operations. In particular, the mobile terminal 20 can use position estimates for a wide variety of purposes, such as to improve channel reselection and hand-off decisions, or to access a database of location specific information depending on the current location of the mobile terminal. For example, pending U.S. Patent application number 09/498,785 entitled "Position Assisted Handoff Within A Wireless Communication Network" discloses a method for making hand-off decisions based on the current location of the mobile terminal 20. U.S. Patent application number 09/505,301 entitled "Position Assisted Service Selection" discloses a method for choosing a service provider based on the current position of the mobile terminal 20. U.S. Patent application number 09/546,720 entitled "Mobile Terminal With Local Area Database" discloses a mobile terminal 20 that uses the current position of the mobile terminal 20 to retrieve location specific information, such as the nearest hotel, from a database in the mobile terminal 20. U.S. Patent Application No. 09/498,772 entitled "System and Method For Improving Channel Monitoring In a Cellular System" discloses a method for monitoring channels on a neighbor list. U.S. Patent Application No. _____ entitled "System Proximity Detection Method By Mobile Stations" discloses a method for acquiring service with a private radio communication system based on proximity to the private system. These applications are incorporated herein by reference.

The present invention is not concerned specifically with how position information is used by the mobile terminal 20 and the above cited examples therefore should not be construed as limiting the invention in any way. It is simply assumed for purposes of

describing the present invention that position information is used in some manner by the mobile terminal 20 for some useful but unspecified purpose. The present invention relates specifically to the manner in which the current position of the mobile terminal 20 is updated. In particular, the present invention relates to a method for controlling the position update frequency of the position estimator 50 based on the distance of the mobile terminal 20 relative to a specific point of interest.

Figure 2 is a flow diagram illustrating an exemplary method for determining the position update frequency of the mobile terminal 20. At block 60, a triggering event causes the control unit 22 to initiate the position update routine. The triggering event may, for example, be the expiration of a timer used by control unit 22 that determines the position update frequency of the mobile terminal 20. This timer (not shown) may be initially set to a predetermined default value and updated as hereinafter described. Upon expiration of the timer or upon the occurrence of some other triggering event, the mobile terminal 20 determines its current position (block 62) and thereafter computes the distance D of the current positon to a reference position corresponding to a point of interest (block 64). Additionally, the mobile terminal 20 may compute the speed or velocity of the mobile terminal 20 based on two or more position estimates over a period of time. In block 66, the mobile terminal 20 adjusts the position update frequency as needed based on the computed distance D, velocity V, or a combination of the distance D and velocity V. At block 68, the mobile terminal can optionally perform additional acts or steps. For example, current position of the mobile terminal 20 may optionally be returned to a calling procedure or application that has requested the current position of the

mobile terminal 20. Additionally, the mobile terminal 20 may take action based on the distance D between the current position of the mobile terminal and the reference position. In this case, the mobile terminal 20 may compare the distance D to a threshold distance at block 70. If the distance D is less than the distance threshold, the mobile terminal 20 may perform a predetermined action (step 72). For example, the predetermined action may comprise acquiring service with an alternate network when the distance D is within a predetermined radius of a reference position of the alternate network, as will be described in greater detail below. After the additional steps represented by block 68 are performed, the position update procedure terminates (block 74).

The algorithm for adjusting the position update frequency of the mobile terminal 20 at block 66 may be as simple or as complex as needed or desired in a particular application. In one embodiment of the invention, the position update procedure employs a sliding scale so that position updating becomes more frequent as the mobile terminal 20 moves closer to the point of interest and becomes less frequent as the mobile terminal 20 moves farther from the point of interest. A sliding scale can be implemented, for example, by comparing the computed distance D of the mobile terminal 20 from the point of interest to one or more predetermined set points and adjusting the update frequency accordingly. By reducing update frequency as the mobile terminal 20 moves away from the point of interest, the power drain on the battery can be significantly reduced.

Figure 3 illustrates one possible application where the control of the position update frequency of a positioning device can be useful. Figure 3 shows a mobile terminal 20 in a vehicle traveling within the coverage area of a public land mobile network 100.

Public land mobile network (PLMN) 100 comprises a base station 110 coupled to an antenna 112. Base station 110 provides radiocommunication services to various mobile terminals 20 within its area of coverage, or cell. Base station 110 is connected to a mobile switching circuit (not shown), which in turn is connected to the public switched telephone network (not shown).

Proximate to PLMN 100, and possibly within or partially within the coverage area of PLMN 100, is a private wireless telephone system (PWTS) 200. PWTS 200 is one example of an alternate network.. PWTS 200 provides radiocommunication services within a facility 205. In the exemplary embodiment described herein, the PWTS 200 is structurally and functionally similar to PLMN 100. PWTS 200 comprises a plurality of base stations 210 located strategically throughout facility 205 to provide continuous coverage to mobile terminals 20 therein. Base stations 210 may be interconnected with a MSC (not shown) in the PLMN 100 or may be interconnected to the public switched telephone network (not shown). Interconnection with the PLMN 100 enables the same mobile terminal 20 to be used in both the PLMN 100 and PWTS 200. Thus, the user is able to roam seamlessly through the PLMN 100 and PWTS 200. Transfer between the PLMN 100 and PWTS 200 in this case are transparent to the user.

Base stations 210 within PWTS 200 are functionally similar to base stations 110 within PLMN 100, but also differ in several respects. Base stations 210 are typically of lower power than those used in the PLMN 100 to avoid interference with the PLMN 100 and, consequently, are deployed closer together to provide coverage over the entire facility 205. An example of a base station 210 designed for use in a PWTS 200 is the

PicoBase™ system produced by Ericsson, Inc. Base station 210 may use the same interface as the PLMN 100, or may employ an alternate interface. One alternate interface is a Bluetooth interface that operates in the 2.45 GHz frequency band.

Facility 205 may comprise any geographic locus, such as a shopping mall, sports arena, office building or park, hotel, apartment complex, airport, university campus, etc. Tenants of facility 205 may wish to provide a private radiocommunication system for use by mobile terminal users therein for a broad variety of reasons, including cost control and increased availability of personnel as users migrate from dependence on desktop telephones to mobile terminals. PWTS 200 is typically operated by a business, such as the tenant of facility 205 or the service may be provided by a third party and leased to such business on a flat rate. In either case, users typically do not incur air-time charges for use of radiocommunication services in PWTS 200. Thus, users approaching and entering facility 205 will generally desire to acquire service with the PWTS 200 whenever possible, to avoid air-time charges incurred when using the PLMN 100.

When a mobile terminal 20 powers on, it will attempt to locate a control channel in either the PLMN 100 or the PWTS 200, from which it can, for example, obtain overhead information regarding system operations, receive paging messages and initiate calls. Various techniques are available for locating control channels in public land mobile networks, which techniques are typically specified by the applicable radiocommunication standards. For example, techniques for finding a control channel once the mobile terminal 20 is ordered to search for a control channel, such as by first ranking all the channels in signal strength, are described in TIA/EIA standard ANSI-136 and ETSI's GSM standard,

which are incorporated herein by reference. An additional example of techniques by which control channels can be located is found in U.S. Patent No. 5,570,467 to Sawyer, entitled "Method and Apparatus for Locating a Digital Control Channel in a Radiocommunication System", and U.S. Patent No. 6, 058, 108 entitled "Method and apparatus for locating a digital control channel in a radiocommunication system," the disclosures of which are incorporated herein in its entirety.

The location of known private systems to which the user has access can be stored in the mobile terminal 20. For example, a central point in the PWTS 200 or other private system may be stored in the mobile terminal 20 as the reference position and the distance threshold may be a radius R which defines an area encompassing the facility 205. When the position estimator 50 indicates that the mobile terminal 20 is close to a known private system (i.e., the distance from the current position of the mobile terminal 20 and the stored location is less than a predetermined threshold distance), the mobile terminal 20 may trigger a search for a control channel associated with the PWTS 200 and acquires service with the PWTS 200 if a control channel is found. The control channel may be a physical channel or a logical channel. If the search is successful, i.e., a control channel is found, the mobile terminal 20 can acquire service with the PWTS 200. If the mobile terminal 20 fails to locate a suitable control channel, it may be programmed to periodically search for a control channel as long as its estimated current position is within the threshold distance from the reference position, on the assumption that the mobile terminal 20 is merely temporarily shielded from the private system's base station 210. Alternatively, the mobile terminal 20 could be programmed to search for a control

channel a predetermined number of times, and then stop searching, on the assumption that the PWTS 200 is inoperative, and further searches would merely waste battery power. In either event, this geographic position approach to initiating the search for the control channel of the PWTS 200 allows a total decoupling of the public and private systems, while simultaneously minimizing the time when the mobile terminal 20 is blind to incoming pages and the current drain associated with geographically indiscriminate periodic control channel searches.

The operation of position estimator 50 increases the current drain on the battery of the mobile terminal 20. Hence, it may not be desired to operate the position estimator 50 on a continuous basis. Other position related applications (e.g., emergency calling) may only activate the position estimator 50 upon request, by a user command or indirectly by the user when enabling an application that utilizes the position of the mobile terminal 20. Thus, if other uses of the position estimator 50 only require infrequent position updates, the current drain of the position estimator 50 to support the locating of private systems, while providing timely discovery of the private systems, may jeopardize the objective of low impact on the current drain of mobile terminal 20.

According to the present invention, the position update frequency may be set by default to a relatively low value and increased as the distance to a point of interest, e.g., the PWTS 200, decreases. Thus, when the position estimator 50 indicates that the mobile terminal 20 is close to a previously learned PWTS 200, the mobile terminal 20 may request the position estimator 50 to update its position with an increased position update frequency in order to avoid any delay in acquiring service with the PWTS 200, while

minimizing the current drain of the position estimator 50 when the mobile terminal 20 is far from any private systems. Thus, the frequency of position update becomes a function of the distance to the PWTS 200.

This function is depicted graphically in Figure 4, wherein the abscissa represents increasing distance between the mobile terminal 20 and the reference position (in km), and wherein the ordinate represents increasing frequency of position updates by the mobile terminal 20 (in min^{-1}). The function, as represented by the first solid curve, is generally decreasing, i.e., of negative instantaneous slope, but may be of any formulation, such as linear, quadratic, inverse exponential, etc., as most effective, and as may be discovered by one of ordinary skill in the art without undue experimentation. The curve reaches a maximum as the user approaches the boundary of the private system, for example at the radius r of a system wherein the stored reference position represents the center of a circular area of coverage. As the user approaches r, mobile terminal 20 updates its position estimate more and more frequently, providing increasingly current estimates of the user's distance from the reference position. This minimizes the delay in triggering a control channel search as the user reaches r (the threshold distance, generally denoting the boundary of the private system).

The dotted curves of Figure 4 represents two possible responses of the update frequency function as the user enters the range of the private radiocommunication system and searches for a control channel. At this point, the mobile terminal 20 may cease updating its position to conserve battery power – assuming that no other function of the mobile terminal 20 is position-dependant. This response is depicted by dotted graph a.

Alternatively, the mobile terminal 20 may default to some intermediate frequency of position update f_d, as depicted by dotted graph b. This would allow the mobile terminal 20 to take advantage of position-dependant resources within the area covered by the PWTS 200. These two responses are illustrative only, and a wide variety of other position estimate update schemes are possible, as desired or required by particular applications.

The second solid curve of Figure 4 represents the control channel search frequency as a function of the distance between the mobile terminal 20 and the reference position. The curve exhibits a step function at the boundary of the PWTS 200. Far from the reference position, no search for a control channel is performed, to preserve battery power. As the mobile terminal 20 moves closer to the boundary of the PWTS 200, the frequency of position updates increases as described above, but still no search for a control channel is initiated, since the mobile terminal 20 is greater than the threshold distance from the reference position, and is thus presumed to be outside of the coverage area of the PWTS 200. When the mobile terminal 20 reaches the boundary of the coverage area at r, a search for a control channel is initiated, as indicated by the step function depicted in the graph. This search is continued, either continuously or periodically, until a control channel for the PWTS 200 is found or until a predetermined number of access attempts have been made. If the search is successful, the mobile terminal 20 switches communications to the PWTS 200 and ceases its search for a control channel.

As a further refinement of this approach, the frequency of position updates may be dependant on the rate of change of distance of mobile terminal 20 from the point of interest. Consider the example of a user within a PWTS 200 having lunch in a place just outside the coverage of the PWTS 200, but very geographically close to the PWTS 200. In this case, as described above, the mobile terminal 20 would update its position frequently since its current position is close to the known reference position of the PWTS 200. This frequent position estimate update would be to minimize the time necessary to acquire service with the PWTS 200 when the user moves within the coverage area of the PWTS 200. In this example, however, the user does not gain any advantage from the frequent position estimate updates, since the user is not moving towards the PWTS 200. In fact, the frequent position estimate updates are counterproductive, as they cause the position estimator 50 to needlessly consume battery power. By reducing the frequency of position estimate updates when the rate of change of calculated distance from the PWTS 200 is low (even when the absolute distance to the PWTS 200 is small), battery power is conserved without a loss of timeliness of detection of the PWTS 200. Following lunch, the user moves back towards the PWTS 200 boundary. The higher rate of change of his distance from the PWTS 200 triggers more frequent position estimate updates. Thus the mobile terminal 20 will trigger its search for the PWTS 200's control channel very soon after reaching the threshold distance. If the user is relatively far from the coverage area of the PWTS 200, the mobile terminal 20 would update its position less frequently due to the increased distance, and the rate of change of that distance would have no impact.

Typically, the user will prefer to use a PWTS 200 over a public one, to minimize usage charges, i.e., air-time charges. Thus the mobile terminal 20 may be designed to maintain service with the PWTS 200 as long as the communication quality is sufficient. Hence, the service selection algorithm in the mobile terminal 20 may not use position estimates from the position estimator 50 to determine when to switch to the less preferred system, for example, a PLMN 100. In this case, the marginal communication quality of the downlink control channel when in idle mode may be used as a trigger event for searching for the PLMN 100. However, in order to avoid "channel dragging," in which the mobile terminal 20 is using, or will be using if a call is placed or received, a channel assigned to the PWTS 200 while far into the PLMN 100 and thereby potentially creating interference, a combination of channel quality and estimated position may be used to determine when to switch to the less preferred system. Alternatively, the threshold distance and rate of change in distance between the mobile terminal 20 and the reference position may be utilized to switch from a private to a PLMN 100 as disclosed herein to switch from a PLMN 100 to a PWTS 200.

The learning of the location of a PWTS 200 by the mobile terminal 20 can take various forms. Once the mobile terminal 20 is camped on the PWTS 200, the PWTS 200 can download a geographic description of its coverage area. Alternatively, the user may download the information provided on, e.g., a corporate WEB site, over a wireless link. In this case, the wireless communication system is used to download the information but is not aware of the content nor initiates the transaction. However loaded, the mobile terminal 20 may discard the information about private systems if they are not visited for

an extended period of time and there is a memory shortage. The user may be prompted about this proposed action.

The format of the location information may take various forms. In its simplest representation, the location is a single position. A more useful representation would be a single position and a radius, defining a circular area. An odd-shaped system may be described by multiple positions defining a boundary, forming a polygon when connected by straight lines. A wide variety of other modes of identifying boundaries of a coverage area may be utilized, as known in the art, and as may be determined by one of ordinary skill without undue experimentation.

The above formats may advantageously be augmented by a height factor, e.g., over sea level or similar reference point. This may add precision, e.g., for a business located in a multi-story building. Thus, the distance from the mobile terminal 20 to the reference location may be computed in three-dimensional space. In all the above formats, it is envisioned that the location information concerning the PWTS 200 will be contained within the operative boundaries of the PWTS 200. As used herein, the term "within the boundaries of" includes within the system or along the boundaries of the system.

The present invention has been explicated herein in reference to an environment comprising a public and a private radiocommunication system, with the PWTS 200 being generally preferred by the user. The invention is not thus limited, however, and may be advantageously employed to switch from any first wireless system to any second wireless system about which geographic extent is known. Thus, as used herein, the term "PWTS 200" refers to its desirability vis a vis the public cellular system, and not to details of

ownership and access. For example, a public wireless system operated at, e.g., a sports arena, wherein air-time rates are lower than the surrounding cellular system, would qualify as a private or alternate system as described herein.

Thus, while the invention has been described illustratively herein with reference to various specific embodiments, aspects and features, it will be recognized that the invention is not thus limited, but encompasses numerous variations, modifications and other embodiments, and accordingly such other variations, modifications and other embodiments are to be regarded as being within the spirit and scope of the invention as claimed.

CLAIMS

What is claimed is:

1. A method for controlling the update frequency of a positioning device in a mobile terminal, said method comprising:

storing at least one reference position in said mobile terminal;determining the current position of said mobile terminal:

computing a distance of said current position of said mobile terminal from said reference position; and

determining a position update frequency based on said distance between said current position of said mobile terminal and said refernce position.

2. The method of claim 1 wherein determining a position update frequency based on said distance between said current position of said mobile terminal and said reference position comprises increasing said update frequency as said distance between said current position of said mobile terminal and said reference position decreases.

3. The method of claim 1 wherein determining a position update frequency based on said distance between said current position of said mobile terminal and said reference position comprises decreasing said update frequency as said distance between said current position of said mobile terminal and said reference position increases.

4. The method of claim 1 further comprising determining the velocity of said mobile terminal based on two or more position estimates.

5. The method of claim 4 wherein determining said position update frequency as a function of said distance between said current positon of said mobile terminal and said reference position further comprises determining said position update frequency as a function of said distance between said current position and said reference position and said velocity of said mobile terminal.

6. The method of claim 5 wherein determining said position update frequency as a function of said distance between said current position of said mobile terminal and said reference position and said velocity of said mobile terminal comprises increasing said position update frequency as said velocity increases and decreasing said position update frequency as said velocity decreases.

7. The method of claim 1 further comprising:

comparing said distance between said current position of said mobile terminal and said reference position to a predetermined threshold; and

performing a predetermined action if said distance between said current position of said mobile terminal and said reference position meets said threshold.

8. The method of claim 7 wherein performing a predetermined action if said distance between said current position of said mobile terminal and said reference position meets said threshold comprises searching for a channel in an alternate network.

9. The method of claim 8 wherein searching for a channel in an alternate network compries searching for a control channel in a private wireless telephone system.

10. A mobile terminal comprising:

a transceiver transmitting and receiving signals over a wireless channel;

memory storing at least one reference position;

a position estimator to periodically determine a current position of said mobile terminal at a variable position update frequency; and

control logic including a processor to calculate the distance of said mobile terminal from said reference position based on said current position of said mobile terminal and to adjust said variable position update frequency as a function of said distance of said mobile terminal from said reference position.

11. The mobile terminal of claim 10 wherein said position estimator is in a removable device removably attached to said mobile terminal.

12. The mobile terminal of claim10 wherein said position estimator comprises a GPS receiver.

13. A method of initiating a search for a control channel in a communications network by a mobile terminal, said method comprising:

storing at least one reference position indicative of the location of said communications network in said mobile terminal;

determining the current position of said mobile terminal;

computing the distance of said current position of said mobile terminal from said reference position; and

initiating a search for a channel based on said distance between said mobile terminal and said communication network.

14 The method of claim 13, including establishing communication between said and said mobile terminal and said communication network.

15. The method of claim of claim 14 wherein establishing communications between said mobile terminal and said communications network comprises establishing communication with a private radiocommunication system.

16. The method of claim 15 wherein establishing communication with a private radiocommunication system comprises establishing communication with said private radiocommunication system via a short-range air interfere.

17. The method of claim 16 wherein establishing communication with said private radiocommunication system via a short-range air interfere comprises establishing communication with said private radiocommunication system via a Bluetooth interface.

18. The method of claim 13, wherein determining the current position of said mobile terminal comprises receiving signals from navigation satellites and calculating said current position from said signals received from said navigation satellites.

19. The method of claim 13, wherein determining said current position of said mobile terminal is repeated at intervals dependant on said distance of said current position of said mobile terminal from said reference position.

20. The method of claim 13, further comprising determining the rate of change in said position of said mobile terminal relative to said reference position.

21. The method of claim 20, wherein determining said current position of said mobile terminal is repeated at intervals dependant on said rate of change of distance of said mobile terminal from said reference position.

22. The method of claim 20, including determining the rate of change in said position of said mobile terminal relative to said reference position and initiating a search for a channel when: (i) said distance between the mobile terminal and the reference position is less than said predetermined distance, and, (ii) said rate of change in said position of said mobile terminal relative to said reference position exceeds a predetermined value.

23. A mobile terminal comprising:

a transceiver transmitting and receiving signals over a wireless channel;

memory storing at least one reference position indicative of the location of a communications network;

a position estimator to determine a current position of said mobile terminal; and

control logic including a processor to calculate the distance of said mobile terminal from said reference position based on said current position of said mobile terminal and to initiate a search for a channel based on said calculated distance.

24. The mobile terminal of claim 23, wherein said position estimator comprises a receiver adapted to receive signals from navigation satellites and to calculate said current position from said received signals.

25. The mobile terminal of claim 23, wherein said control logic further calculates the rate of change of said current position relative to said reference position.

26. The mobile terminal of claim 25, wherein said control logic updates saidcurrent position at a frequency dependant on said rate of change of said current position relative to said reference position.

27. The mobile terminal of claim 23, wherein said control logic further calculates the rate of change of said current position of said mobile terminal relative to said reference position, and initiates a search for a channel based on said calculated distance between said mobile terminal and said reference position and said rate of change of said current position of said mobile terminal relative to said reference position.

28. The mobile terminal of claim 23 wherein said mobile terminal further comprises a Bluetooth interface.

29. A method for controlling the initiation of searches by a mobile terminal for a channel associated with a private radiocommunication system, said method comprising:

storing a reference position within the mobile terminal, said reference position being within the boundaries of the private radiocommunication system;

determining the current position of said mobile terminal;

computing the distance of said current position of said mobile terminal from said reference position; and

initiating a search for a channel provided by said private radiocommunication system based on said computed distance between said current position of said mobile terminal and said reference position.

30. The method of claim 29, wherein determining the current position of said mobile terminal and computing the distance of said current position of said mobile terminal from said reference position are preformed repeatedly.

31. The method of claim 29, wherein said mobile terminal repeatedly searches for a channel provided by said private radiocommunication system as long as said distance of said current position of said mobile terminal from said reference position is less than said predetermined distance.

32. The method of claim 29, further including determining the rate of change of said distance between said current position of said mobile terminal and said reference position and initiating a search for a channel provided by said private radiocommunication system in response to: (i) said rate of change being greater than a predetermined value, and, (ii) said distance between said current position of said mobile terminal and said reference position being less than a predetermined distance

33. The method of claim 29, wherein initiating a search for a channel provided by said private radiocommunication system is further based on the rate of change of said distance between said current position of said mobile terminal and said reference position.

34. A method of controlling the initiation of a search by a mobile terminal for a channel associated with a radiocommunication system comprising:

repeatedly determining the location of the mobile terminal with respect to a reference position associated with the radio communication system; and

initiating a search for a channel associated with said radio communication system if the computed distance between the mobile terminal and the reference position is less than a predetermined distance.

35. The method of claim 34 further comprising:

repeatedly determining the rate of change of said distance between said mobile terminal and said reference position; and

initiating a search for the channel associated with said radio communication system when:

(i) the distance between said mobile terminal and said reference position is less than said predetermined distance, and,

(ii) (ii) when the rate of change of the distance between said mobile terminal and said reference position exceeds a predetermined value.

ABSTRACT OF THE DISCLOSURE

A mobile radiocommunications terminal contains or is operatively connected to a position estimator, such as a GPS receiver. The mobile terminal stores at least one reference position. The mobile terminal updates its position at a frequency that is a function of its distance from the reference position, or as a function of the rate of change of its distance from the reference position.

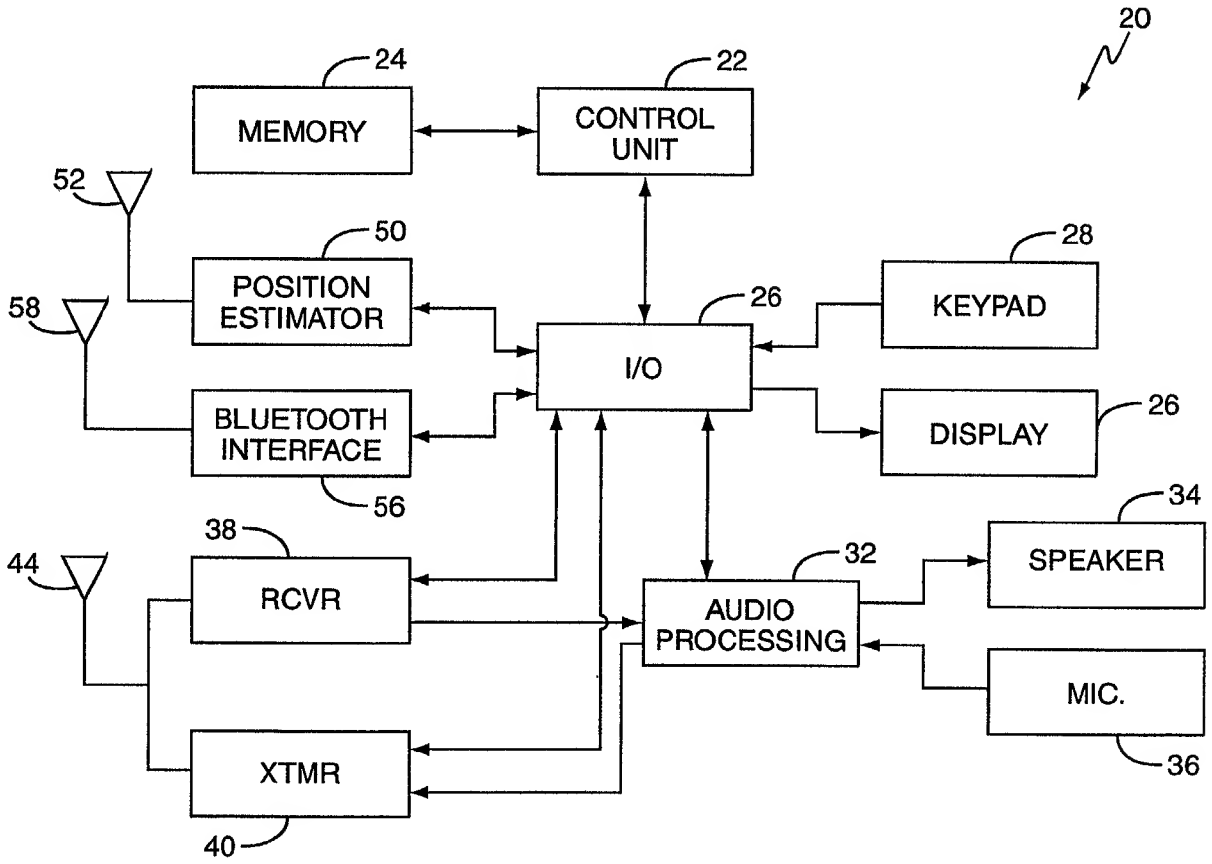

FIG. 1

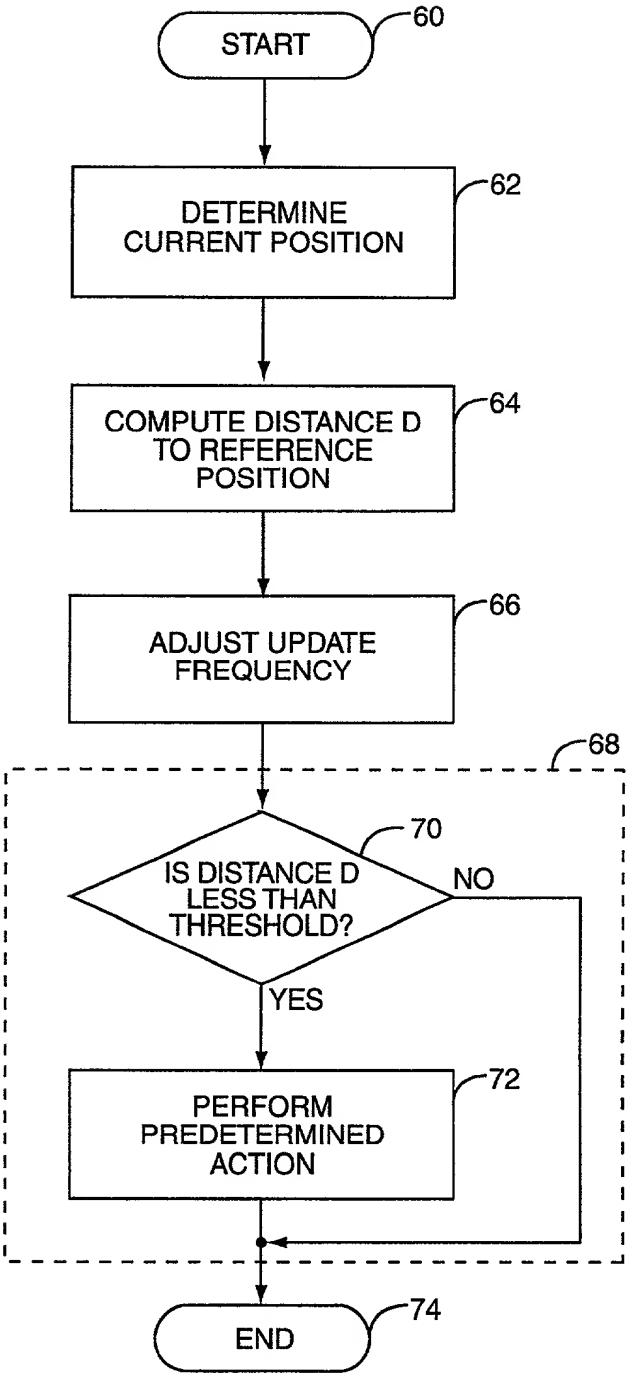
START
60
DETERMINE CURRENT POSITION
62
COMPUTE DISTANCE D TO REFERENCE POSITION
64
ADJUST UPDATE FREQUENCY
66
68
IS DISTANCE D LESS THAN THRESHOLD?
70
NO
YES
PERFORM PREDETERMINED ACTION
72
END
74

FIG. 2

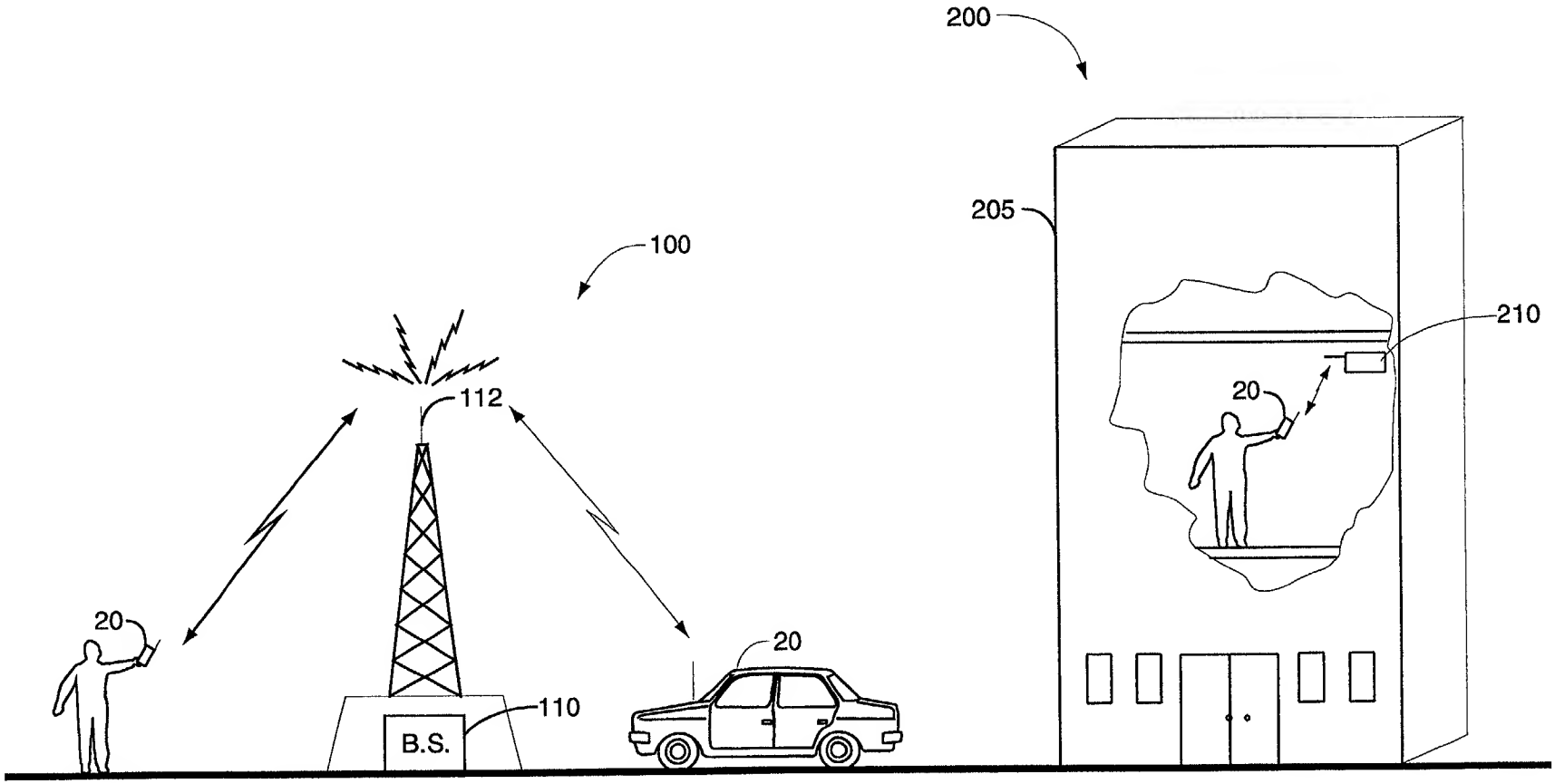

FIG. 3

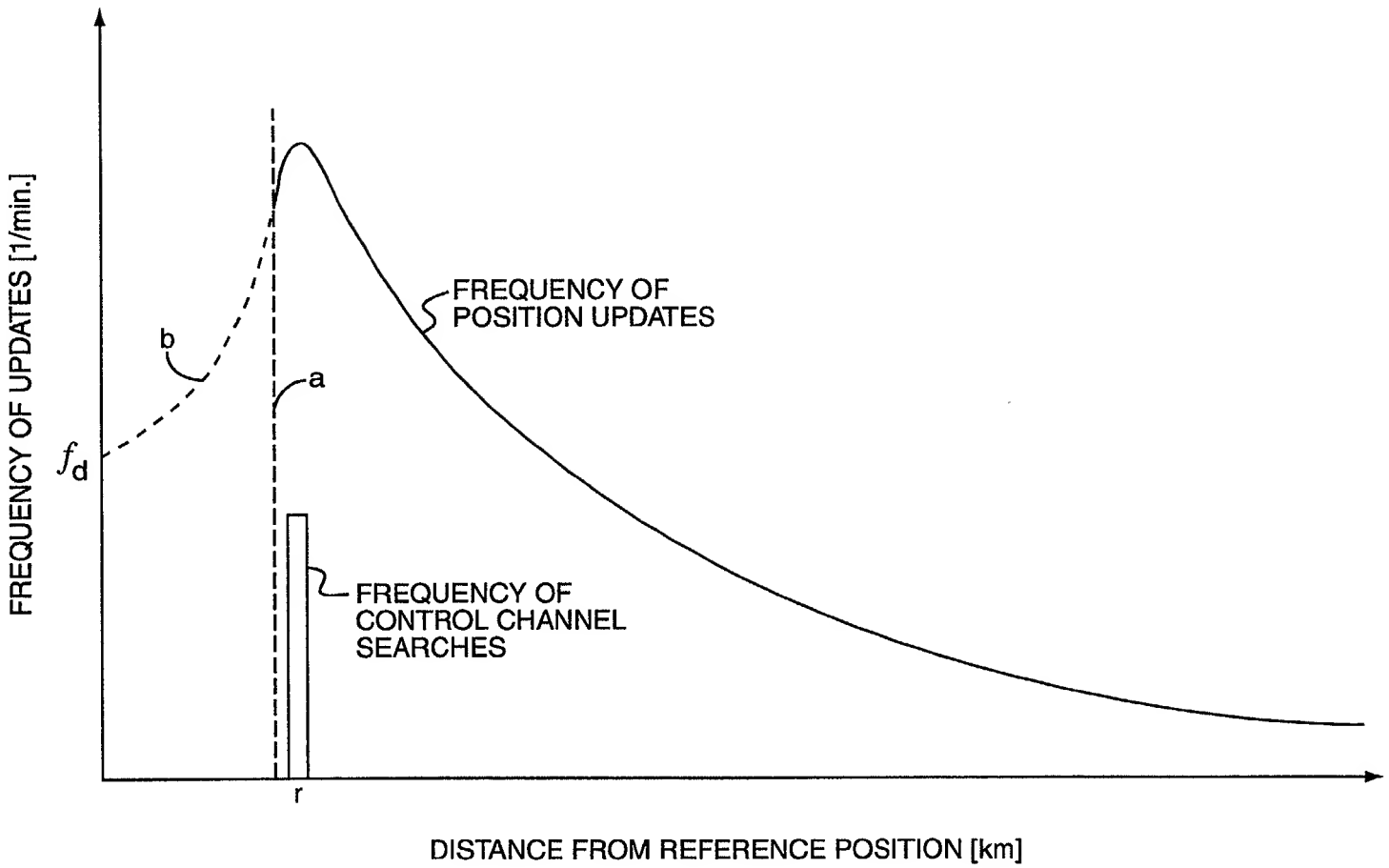

FIG. 4

Attorney Docket Number
P-4015.677/P12448(US1)-RCUR

Declaration and Power of Attorney for Patent Application

As below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe that I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **METHOD TO CONTROL THE UPDATE FREQUENCY OF A POSITIONING DEVICE IN A MOBILE TERMINAL**, the specification of which

[X] is attached hereto.

(Check one)

[ ] was filed on _____ as
Application Serial Number _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me which is material to patentability (as defined in C.F.R. §1.56) in connection with the examination of this application.

I hereby claim foreign benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
NONE (Number)	(Country)	(Day/Month/Year Filed)	[ ] YES	[ ] NO
(Number)	(Country)	(Day/Month/Year Filed)	[ ] YES	[ ] NO
(Number)	(Country)	(Day/Month/Year Filed)	[ ] YES	[ ] NO

Attorney Docket Number
P-4015.677/P12448(US1)-RCUR

Declaration and Power of Attorney for Patent Application

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

NONE (Application Serial No.)	(Filing Date)	(Status: Patented/Pending/Abandoned)
(Application Serial No.)	(Filing Date)	(Status: Patented/Pending/Abandoned)

Power of Attorney: As a named inventor, I hereby appoint the following agents/attorneys to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Kermit D. Lopez
Registration Number 41,953

David K. Purks
Registration Number 40,133

Debra K. Stephens
Registration Number 38,211

Kevin A. Sembrat
Registration Number 36,673

Mark C. Terrano
Registration Number 40,200

Stephen A. Calogero
Registration Number 41,491

Dennis J. Williamson
Registration Number 32,338

David R. Irvin
Registration Number 42,682

I. Nelson Wakefield
Registration Number 45,190

Thomas M. Croft
Registration Number 44,051

Gary R. Kuhn
Registration Number 44,198

Jon Han
Registration Number 41,403

Attorney Docket Number
P-4015.677/P12448(US1)-RCUR

Declaration and Power of Attorney for Patent Application

And I also hereby appoint the Attorneys and Patent Agents of **Coats & Bennett, P.L.L.C.**, as identified by **Customer Number 24112** in the records of the United States Patent and Trademark Office and as updated from time to time, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Send Correspondence to:	David E. Bennett
Direct Calls to:	David E. Bennett

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SOLE OR FIRST INVENTOR:

Full name: Alex (First Name) Krister (Middle Name/Initial) Raith (Last Name)

Signature: Alex Krister Raith (First Name, Middle Name, Last Name) Date: 2000-09-06 (Year-Month-Day)

Residence: San Diego, California, USA (City, State, and Country)

Citizenship: Sweden

Post Office Address: 7555 Charamant Drive, #1108, San Diego, California 92122